嘉庚號
TAN KAH KEE

# 坚守

2020

# R/V TAN KAH KEE
## — Annual Report —

# 千古颂嘉庚

## In Honor of Tan Kah Kee

“嘉庚”号科考船（R/V TKK），2015年3月开工建造，2016年5月下水暨命名，2017年4月正式交付并投入使用，是由厦门大学拥有完全知识产权的3000吨级海洋科学综合考察船。以“嘉庚”号命名，是为了缅怀厦门大学校主、著名爱国侨领陈嘉庚先生（Mr. Tan Kah Kee）。

Construction began in March 2015, launched and named in May 2016, officially delivered and put into service in April 2017, research vessel Tan Kah Kee (R/V TKK) is one of the most advanced and versatile research vessels in China. Xiamen University (XMU), as the owner, possesses the full intellectual property rights of its one-of-a-kind design. The new vessel was named in memory of our great founding father, the renowned patriotic overseas Chinese leader Mr. Tan Kah Kee, who established XMU in 1921. Since then, having a modern, highly capable research ship has been a century-long dream for generations of XMU's oceanographic community.


## “嘉庚”号的使命
## Mission of R/V TKK

“嘉庚”号的使命，是为海上现场的科学研究和人才培养提供最佳的装备、技术和运行的支撑与保障。

R/V TKK’s mission is to provide the best possible facility, technical and operational assets to meet seagoing scientific and educational mission requirements of academic community.

## “嘉庚”号的愿景
## Vision of R/V TKK

安全 SAFETY

高效 EFFICIENCY

先进 ADVANCEMENT

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# 寄语 / From the Director

即将过去的 2020，又一个极其不平凡的庚子之年。“嘉庚”号全年的运行，见证了 366 个日日夜夜的坚守。

这一年，新冠疫情在全球肆虐，所有人的工作、出行以及生活的方方面面，都受到了严重影响。科考船的运行，跟国际海运界一样，遇到了前所未有的困难与挑战。因为跨国旅行与口岸防疫的诸多限制，第三届“海丝学堂”航次无法执行，再访马来西亚的计划被迫取消；疫情期间的各类防控要求，使得每一个参加出海的人员，不得不规划出更多的时间、更多的费用来应对航前航后的特殊安排……

面对严峻的新冠肺炎疫情，船管中心及时调整年度船期安排，编制《“嘉庚”号科考船防控新型冠状病毒肺炎疫情工作方案》，细致落实各项航次疫情防控措施和工作预案。我们还联合了厦门大学附属翔安医院、东海第二救助飞行队，开展了今年我国唯一有科考船参与的“海—陆—空”联合疫情防控应急演练，保障了疫情防控应急方案的实操性和可行性。截至 11 月底，“嘉庚”号执行航次作业 218 天，这一数字甚至还超过了去年同期！在这疫情之年，随船出航的 301 人次全员身体健康，未出现任何身体异常状况。

在这 218 天中，有近一半的时间用来执行基金委南海中部的共享航次。4 月中旬，“嘉庚”号率先出航，最早执行今年基金委的共享航次；在 KK2002 南海地质地球物理共享航次期间，还正式启动了“嘉庚号海洋大讲堂”项目，它让中小学科学教师全程参与海上航次，将课堂开设在科考船上，是针对海洋基础教育的创新性长期计划；盛夏时节，KK2003 航次又接连创下“嘉庚”号海上作业的新纪录：单航次累计采水量最高达 51840 升，51 天海上连续工作航程近 7500 海里，也创下单航次最长纪录。它是基金委重大项目“海洋荒漠生物泵固碳机理及增汇潜力”(Carbon Fixation and Export in the oligotrophic ocean, Carbon-FE) 夏季西北太平洋调查任务，也是“嘉庚”号执行的第二个国际 GEOTRACES 研究计划认证航次。

展望 2021 年，厦门大学即将迎来她的百岁生日，“嘉庚”号也将融入一系列的庆祝活动。我们更希望，国际合作抗疫的努力能够加快人们获得新冠疫苗接种的速度，在舒缓并有效控制全球大流行中发挥重要作用。只有这样，科考船的海上作业才能逐步地恢复往常的形态，海洋学子们翘首企盼的“海丝学堂”航次才能重新回到我们的年度计划表当中来……

2021，让我们期待，这个世界的复元！

于 2020 年 12 月

The R/V TKK operation throughout 2020, an extremely unusual year, has witnessed our perseverance for 366 days and nights.

This year, the COVID-19 pandemic swept the whole world. All aspects of work, travel and life of everyone were severely affected. Just like the international shipping industry, the operation of a research vessel has encountered unprecedented difficulties and challenges. Due to the numerous restrictions on international travel and port epidemic prevention, the third “XMU at Sea” cruise could not be implemented, and our plan to revisit Malaysia was forced to be cancelled; various prevention and control requirements during the pandemic coerced every participant to spend more time and more expenses to deal with all kinds of special arrangements during their port calls.

Facing this severe COVID-19 pandemic, we adjusted our 2020 ship scheduling in time, compiled the “Guidelines on COVID-19 Epidemic Prevention and Control for R/V TKK”, and carefully implemented all measures needed during every cruise. We also conducted a ship-to-shore cruise emergency drill jointly with Donghai No.2 Flying Service of Ministry of Transport and Xiang’an Hospital of Xiamen University to ensure the practicality and feasibility of our emergency plan. Our ship sailed 218 days in total—even more than last year! All 301 participants who sailed onboard R/V TKK were in good health.

Nearly half of the time was spent on the NSFC Open Research Cruises (NORC) in the central South China Sea (SCS). In mid-April, our R/V TKK was the first to sail out to implement the NORC cruises. During the KK2002 cruise, the “Teacher at Sea onboard R/V TKK” project was officially launched, which allowed K-12 science teachers to participate our research cruise and present their class on our research ship. This is going to be an innovative long-term plan for ocean science basic education. In high-summer we all witnessed new records out of the longest KK2003 cruise: up to 51,840 liters of seawater was sampled; the range was nearly 7,500 nautical miles in this 51-day expedition. This Carbon-FE northwestern Pacific Cruise in summer, coded as GPpr15, was the second international cruise led by XMU scientists and also endorsed as GEOTRACES Process Study.

Next year, XMU is going to celebrate her 100th birthday, and our R/V TKK will indeed be part of a series of carnivals. We hope that international collaborations to fight against COVID-19 can speed up people’s access to the new vaccine and play an important role in mitigating and effectively controlling this pandemic. Only in this way can the marine operations of research vessels gradually return to its normal form, and the “XMU at Sea” cruise that our students have been waiting for can return to our ship’s annual schedule.

In 2021, let us pray together that our prosperous planet will be fully recovered.

王海黎

Haili Wang
December 2020

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# 疫情之下率先起航
# First Resumed RV Operation during the COVID-19 Pandemic

4 月 15 日，“嘉庚”号科考船于国内高校科考船中率先起航，赴南海执行新冠肺炎疫情以来的首个科考航次。得益于科学严格的航次疫情防控措施，全年随船参航人员全部身体健康，未出现异常状况。

On April 15, Marine Operations (XMU) resumed seagoing operations of R/V TKK. It was China's first institution to return to operations of research vessels during the COVID-19 outbreak. Epidemic prevention and control measures were prudently taken to ensure the safety and health of all cruise participants throughout the year, and they all accomplished the expeditions and returned safe and sound.


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# 嘉庚号海洋大讲堂
# Teacher at Sea onboard R/V TKK

6 月，面向我国海洋基础教育的“ 嘉庚号海洋大讲堂 ”在“ 嘉庚 ”号 KK2002 航次中正式启动。6 月 15 日，首场网络直播课在南海开讲，全网持续关注总量突破 500 万。

In June, “Teacher at Sea onboard R/V TKK” was officially launched during the KK2002 cruise. The initiative is an innovative attempt open to China’s K-12 ocean science education. On June 15, the first online lecture was held onboard, and its related coverage on cyber media exceeded five million hits.

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GEOTRACES

Subject: GEOTRACES Process Study Endorsement

Dear Prof. Dai, Dr. Lu, Dr. Chen and Dr. Huang,

On behalf of the international GEOTRACES programme, we are pleased to let you know that the GEOTRACES Scientific Steering Committee has approved your proposed cruise "Carbon Fixation and Export in the Oligotrophic Ocean (Carbon-FE, KK2003)" on the R/V TAN KAH KEE to be endorsed as GEOTRACES Process Study and has been given the code GPpr15.

We are glad to know that your proposed work will follow international GEOTRACES protocols relating to intercalibration (https://www.geotraces.org/intercalibration/standards/). It is critical that chemical measurements in seawater made during one research cruise can be directly compared with those from other regions made by different labs.

Similarly, we are pleased to know that you will follow GEOTRACES data management protocols (https://www.bodc.ac.uk/geotraces/data/policy/) so that your work can be effectively integrated into international datasets.

Finally, we inform you that a guide to GEOTRACES cruise chief scientists is available on the GEOTRACES web site < https://www.geotraces.org/?q=node/1 >. We kindly ask you to read and follow this guide carefully.

We wish you every success with your cruise and look forward to seeing data from your cruise contribute to the multinational efforts of the GEOTRACES programme.

Yours sincerely,

Prof. Karen Casciotti
kcasc@stanford.edu

Prof. Andrew Bowie
Andrew.Bowie@utas.edu.au

Co-chairs, GEOTRACES Scientific Steering Committee

www.geotraces.org

SCOR

## GEOTRACES计划认证航次

## Carbon-FE Cruise Endorsed as GEOTRACES Process Study

7 月 3 日至 8 月 22 日，“ 嘉庚 ” 号顺利完成 KK2003 国家自然科学基金重大项目 “ 海洋荒漠生物泵固碳机理及增汇潜力 ”（Carbon Fixation and Export in the oligotrophic ocean, Carbon-FE） 夏季西北太平洋调查任务（以下简称 “Carbon-FE 夏季西太平洋科考航次 ”）。通过多学科、多平台、多仪器同步观测与采样，航次于 51 天内完成海上作业近 400 项。本航次是 “ 嘉庚 ” 号执行的第二个国际 GEOTRACES（痕量元素和同位素海洋生物地球化学循环）研究计划认证航次，认证编号为 GPpr15。

From July 3 to August 22, the NSFC major research program—“Carbon Fixation and Export in the oligotrophic ocean, Carbon-FE” in the northwestern Pacific Ocean in summer (Carbon-FE northwestern Pacific Cruise in summer) was accomplished onboard R/V TKK during the KK2003 cruise. More than 400 over-the-side operations were conducted during the 51-day cruise. This multi-disciplinary exploration was the second international cruise led by Chinese scientists and endorsed as GEOTRACES Process Study (GPpr15).

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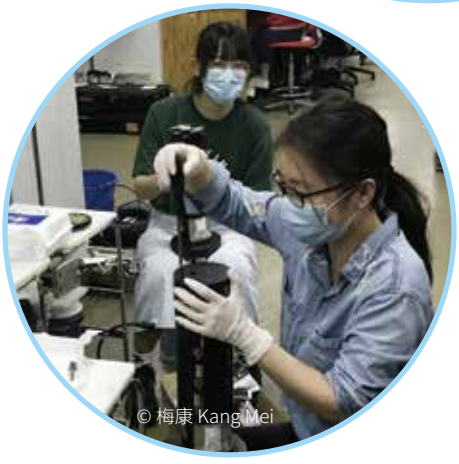
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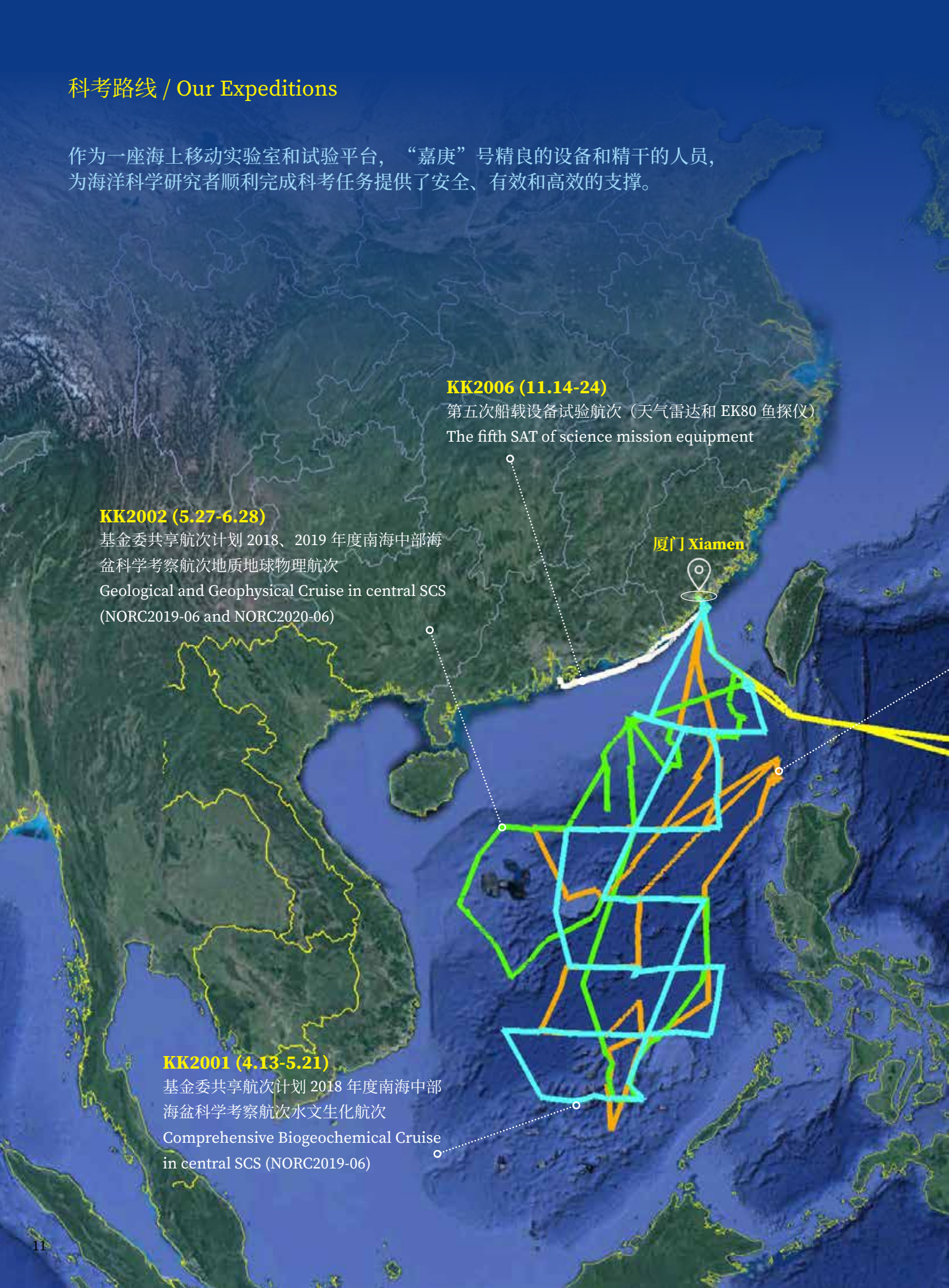
## 基金委共享航次
## NSFC Open Research Cruise (NORC)

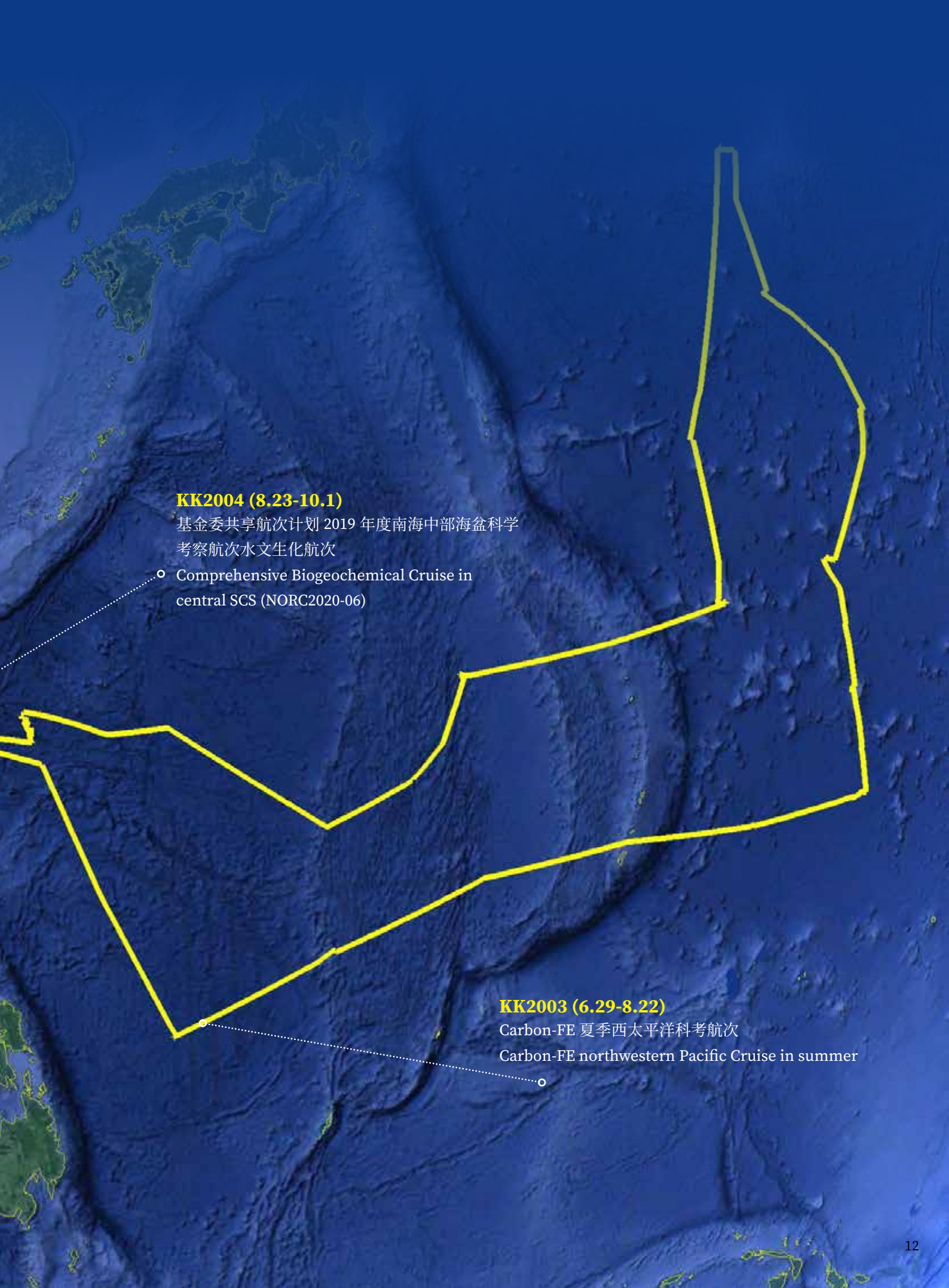
“嘉庚”号分三个航次圆满完成“国家自然科学基金共享航次计划 2018 年度和 2019 年度南海中部海盆科学考察实验研究 (NORC2019-06 和 NORC2020-06)”调查任务，合计航次作业 111 天，累计搭载基金项目 53 项，获取大量宝贵数据资料和样品。

In 2020, three NORC cruises (KK2001, KK2002 and KK2004) were implemented onboard R/V TKK in the central SCS (NORC2019-06 and NORC2020-06). These cruises supported 53 NFSC-funded projects and obtained valuable data and samples, with a total of 111 days at-sea operations.

# 科考路线 / Our Expeditions

作为一座海上移动实验室和试验平台，“嘉庚”号精良的设备和精干的人员，
为海洋科学研究者顺利完成科考任务提供了安全、有效和高效的支撑。




KK2004 (8.23-10.1)
基金委共享航次计划 2019 年度南海中部海盆科学考察航次水文生化航次
Comprehensive Biogeochemical Cruise in central SCS (NORC2020-06)
KK2003 (6.29-8.22)
Carbon-FE 夏季西太平洋科考航次
Carbon-FE northwestern Pacific Cruise in summer

# 0 异常

各航次严格落实疫情防控措施，全年随船参航的 301 人次人员均未出现身体异常状况。

Epidemic prevention and control measures were strictly implemented during all cruises throughout the year, and all 301 cruise participants accomplished the expeditions and returned safe and sound.

# 6 次 218 天 22000 海里

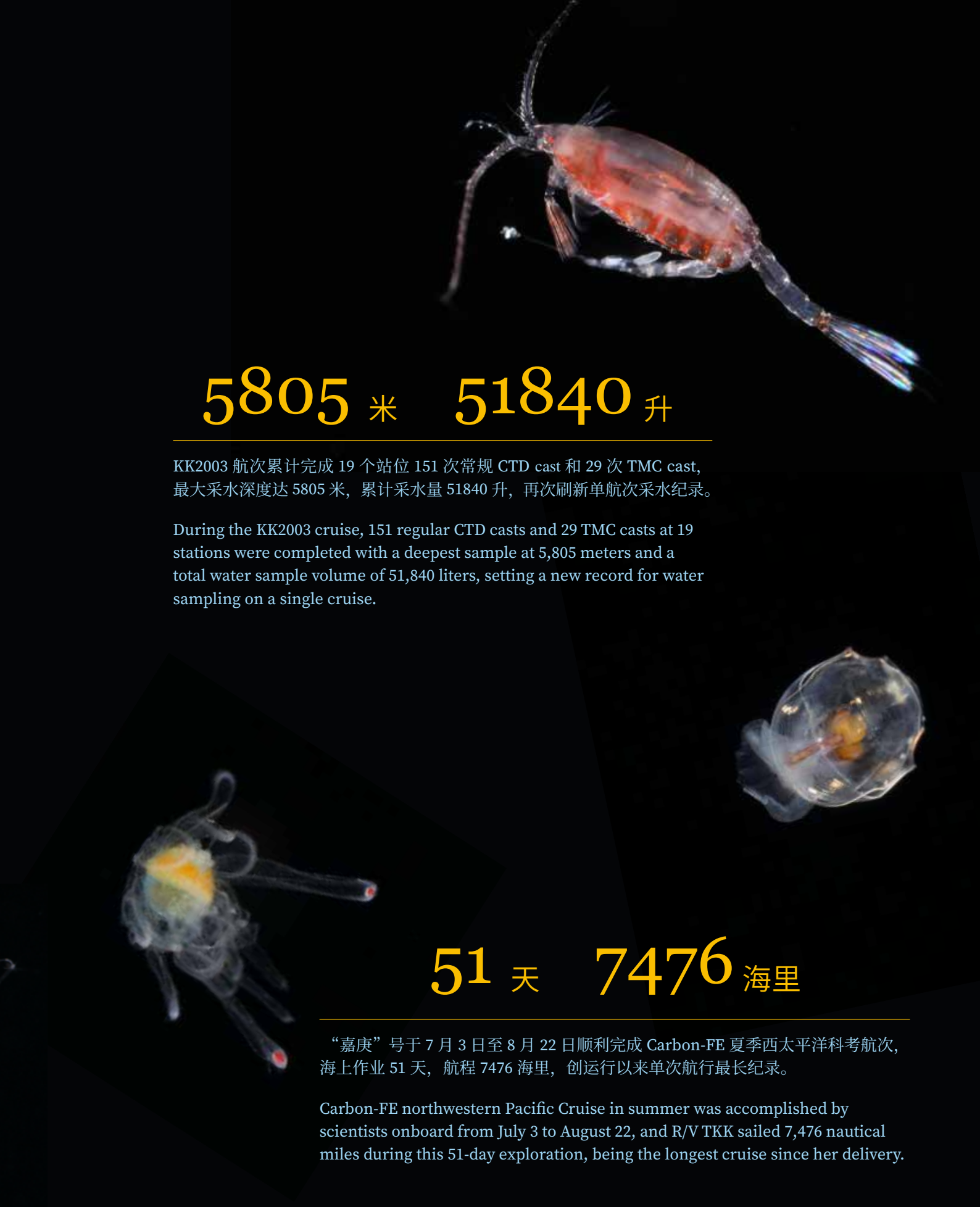
受疫情影响，“嘉庚”号年度首航推迟至 4 月中旬执行。至 11 月底，在南海和太平洋海域共完成 6 个科考航次，航次作业 218 天，总航程约 22000 海里。

Due to the COVID-19 pandemic, Marine Operations (XMU) suspended seagoing operations and resumed until mid-April. By the end of November, six research cruises were accomplished, which took 218 at-sea working days in total, and sailed around 22,000 nautical miles.

# 500 万

KK2002 航次中，“嘉庚号海洋大讲堂”首场直播课网络总流量超 100 万，相关系列报道全媒体持续关注总量突破 500 万。

During the KK2002 cruise, the first online lecture of “Teacher at Sea onboard R/V TKK” initiative attracted more than one million online viewers, and its related coverage on cyber media exceeded five million hits.



# 5805 米　51840 升

KK2003 航次累计完成 19 个站位 151 次常规 CTD cast 和 29 次 TMC cast，最大采水深度达 5805 米，累计采水量 51840 升，再次刷新单航次采水纪录。

During the KK2003 cruise, 151 regular CTD casts and 29 TMC casts at 19 stations were completed with a deepest sample at 5,805 meters and a total water sample volume of 51,840 liters, setting a new record for water sampling on a single cruise.

# 51 天　7476 海里

“嘉庚”号于 7 月 3 日至 8 月 22 日顺利完成 Carbon-FE 夏季西太平洋科考航次，海上作业 51 天，航程 7476 海里，创运行以来单次航行最长纪录。

Carbon-FE northwestern Pacific Cruise in summer was accomplished by scientists onboard from July 3 to August 22, and R/V TKK sailed 7,476 nautical miles during this 51-day exploration, being the longest cruise since her delivery.

# 大事记 / Memorabilia

## 1月/ January

1 月 4 日，“嘉庚”号与厦门大学航空航天学院首次开展科研合作，为其研制的无人机提供放飞试验平台，首尝“海空联动”。

On January 4, the initial ship-borne testing of an unmanned aerial vehicle onboard R/V TKK was cooperatively conducted by School of Aerospace Engineering (XMU) and Shipboard Technical Support (STS) of Marine Operations (XMU).

## 4月/ April

4 月 15 日，在常态化疫情防控形势下“嘉庚”号开启年度首航，赴南海执行国家自然科学基金共享航次。

On April 15, Marine Operations (XMU) resumed seagoing operations during the COVID-19 pandemic, and R/V TKK sailed in the SCS under the circumstances of rigorous epidemic prevention and control.

## 5月/ May

5 月 20 日，“嘉庚”号在 KK2001 航次返航途中加入正在福建近海开展“有害赤潮同步观测和预警预报研究”的百人科研团队，历时 7 小时对厦门湾外断面 6 个站位进行采样。

On May 20, more than 100 researchers carried out a multi-ship monitoring of a harmful algal bloom event in the coastal waters of Fujian. Research groups onboard R/V TKK accidentally joined this campaign en route the inbound of KK2001 cruise. Six stations were occupied during 7-hour operations at Xiamen Bay.

## 6月/ June

6 月 1 日，KK2002 基金委 2018 年度和 2019 年度南海中部海盆共享航次（NORC2019-06 和 NORC2020-06）地质地球物理航次起航。航次中首设面向海洋基础教育的“嘉庚号海洋大讲堂”计划，该计划的首场直播课于 6 月 15 日在南海开讲。

On June 1, the geological and geophysical cruise in the central SCS (NORC2019-06 and NORC2020-06) was conducted onboard R/V TKK. During the cruise, “Teacher at Sea onboard R/V TKK” program to innovate China’s K-12 ocean science education was officially launched.

4 月 16 日，联合厦门大学附属翔安医院和东海第二救助飞行队，开展防疫期间国内首次海陆空联合紧急医学救援演练。

On April 16, the first ship-to-shore cruise emergency drill in response to COVID-19 outbreak was successfully conducted onboard R/V TKK, jointly cooperated with Donghai No.2 Flying Service of Ministry of Transport and Xiang’an Hospital of Xiamen University.

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## 8月/ August

8 月 22 日，Carbon-FE 夏季西太平洋科考航次圆满完成，为期 55 天。

On August 22, the 55-day Carbon-FE northwestern Pacific Cruise in summer, an NSFC major program led by XMU, was successfully accomplished.


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## 7月/ July

7 月 3 日，“嘉庚”号第三次取得厦门海关签发的《船舶免予卫生控制措施证书》。

On July 3, “Ship Sanitation Control Exemption Certificate” was issued by Xiamen Customs District P.R.China for R/V TKK, which was the third “Health Passport” for R/V TKK.

## 10月/ October

10 月 1 日，KK2004 基金委 2019 年度南海中部海盆共享航次（NORC2020-06）水文生化航次顺利完成，为期 40 天。

On October 1, the 40-day comprehensive biogeochemical cruise in the central SCS (NORC2020-06) was accomplished.

## 11月/ November

11 月 24 日，KK2006 多普勒天气雷达及 EK80 鱼探仪海试航次完成，为期 11 天。

On November 24, the sea trials of Doppler weather radar and EK80 equipment were completed, which lasted for 11 days.

## 12月/ December

12 月 23 日，“嘉庚”号再赴西太平洋执行 Carbon-FE 项目冬季科考航次，航期约 45 天。

On December 23, scientists embarked on another 45-day journey to the northwestern Pacific to implement the winter expedition of “Carbon-FE” onboard R/V TKK.

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# “嘉庚”号科考船
# R/V TKK


**主要指标**

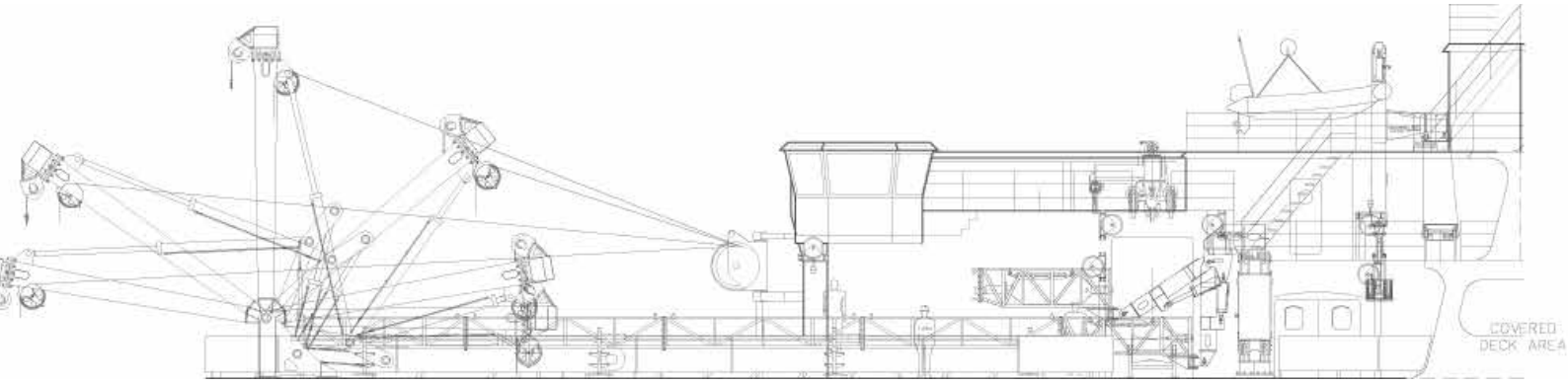
船长：77.70米
型宽：16.24米
设计吃水：5.0米
总吨：3,611
经济航速：11节
最高航速：> 14节
续航力：> 12,500海里
自持力：> 50天
定员：54人
工作甲板面积：432平方米
实验室面积：407平方米

**General specifications**

Overall length ..... 77.70 m
Beam ..... 16.24 m
Draft ..... 5.0 m
Gross Tonnage ..... 3,611
Operational speed ..... 11 knots
Maximum speed ..... > 14 knots
Range ..... >12,500 nm
Endurance ..... > 50 days
Area of Working Deck ..... 432 $m^2$
Area of Laboratories ..... 407 $m^2$
Capacity ..... 54 (18 Crew, 36 Scientists)


“嘉庚”号为海洋科考事业提供先进的设备支撑和专业的技术支持。该船具备出色的设备收放与操控能力，采用全电力推进，装备高性能声学设备，具备高精度动力定位功能，支持信息数据远程传输，可在所有无冰洋区承担多学科海上综合考察任务。

R/V TKK strives to provide safe, efficient and advanced shipboard technical support to oceanographic expeditions. Commissioned with tailor-designed low-noise electric propulsion system, the vessel has outstanding science handling abilities, equipped with state-of-the-art acoustic transducers, with highly precise dynamic positioning performance and broad-band data transmission capability, enabling it to carry out multi-disciplinary field observations in global ice-free waters.


## 甲板作业支撑装备
## Launch and Recovery System

收放装备

艉部A型架：15T

甲板主吊：20T@10m, 13T@15m

右舷伸缩吊：15T@0m, 6T@5m

CTD收放系统SWL：2.5T

船艉辅助吊：4.5T@11.3m

船艏辅助吊：1T@7M

长柱状翻转机构SWL：8T

绞车系统

水文绞车（铠装同轴缆：φ8.18×8000m）

CTD绞车（铠装同轴缆：φ8.18×10000m）

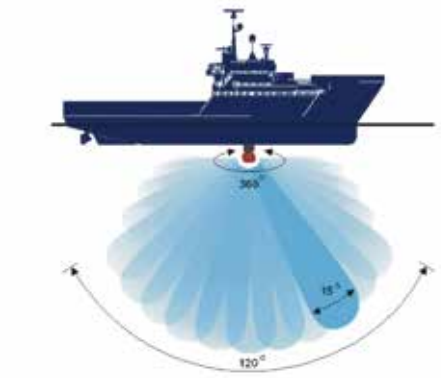
地质钢缆绞车（钢缆：φ14.3×15000m）

光电缆绞车（光电缆：φ17.3×10000m）

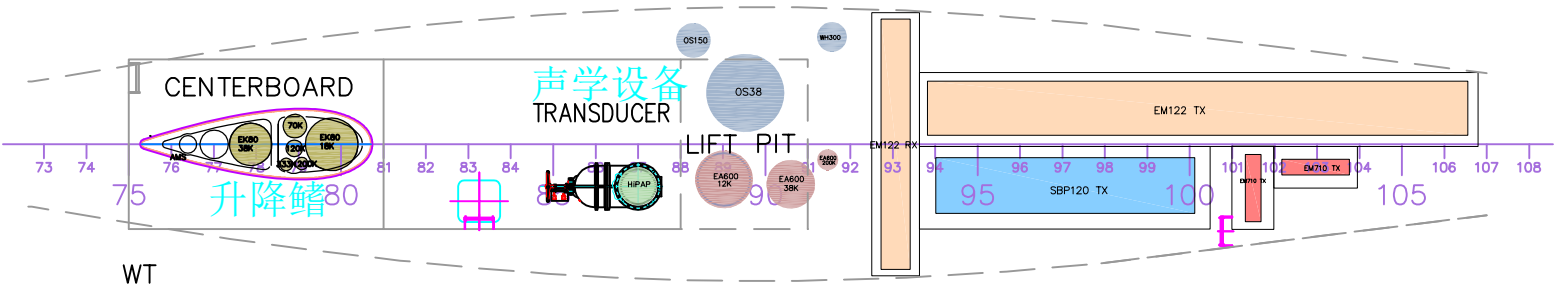
痕量金属专用洁净绞车（φ15.25mm×8000m，集装箱）

大体积泵专用洁净绞车（φ9.525mm×4000m，集装箱）

## 主要船载海洋科学探测设备
## Major Science Mission Equipment



- 全水深多波束测深系统- Kongsberg EM 122 (1° x 2°)
- 中浅水多波束测深系统- EM 710 (1° x 1°)
- 全水深浅地层剖面仪- SBP120 (6°)
- 多频高精度测深系统- EA600 (12/38/200 kHz)
- 分裂波束声学探测系统- EK80 (18/38/70/120/200/333 kHz)
- 深水超短基线声学定位系统- HiPAP 101
- 声学多普勒海流剖面仪 (ADCP)- OS 38 /OS150 /WH300





SWL 15T : 2.7M
SWL 6T : 7.7M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# 全面防控，安全出航

2020 年年初，面临严峻的新冠肺炎疫情，科考船运行管理中心（以下简称“船管中心”）及时调整年度船期安排，第一时间成立科考船疫情防控工作组，编制《“嘉庚”号科考船防控新型冠状病毒肺炎疫情工作方案》，落实落细各项航次疫情防控措施和工作预案，积极为复航做准备。

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疫情防控的本意是关怀到人，疫情防控的关键是落实到点。结合航次工作实际，船管中心针对各航次的科考工作特点及出航人员组成，梳理制定了一系列疫情防控工作方案，主要包括：建立出海人员健康管理台账；组织专业机构对全部参航人员进行 2 次核酸检测与 1 次血清检测；邀请感染管理科医生登船做防疫专题讲座等。

4 月 15 日，在综合研判疫情防控形势与充分做好防疫准备的前提下，“嘉庚”号于国内高校科考船中率先出航，赴南海执行年度首个科考航次，并在航行途中联合厦门大学附属翔安医院、东海第二救助飞行队，在厦门近海海域开展了“海—陆—空”联合疫情防控应急演练。本次演练不仅贯彻落实了交通运输部、外交部、国家卫生健康委、海关总署以及国家移民管理局联合发布的《关于疫情防控期间针对伤病船员紧急救助处置的指导意见》中的有关要求，而且进一步完善了疫情防控应急方案的实操性和可行性。

截至 11 月底，在“嘉庚”号执行航次作业的 218 天时间内，随船参航的 301 人次人员全部身体健康，未出现身体异常状况。


The early season of 2020 witnessed the severe challenges caused by the COVID-19 pandemic. Recognizing the health and safety risks posed by the continued spread of virus, Marine Operations (XMU) promptly developed “Guidelines on COVID-19 Epidemic Prevention and Control for R/V TKK” to proactively prepare for the resumption of the forthcoming cruise. This guidance provided the following:

- Specific preventive guidelines for R/V TKK.
- Establishing an interim panel.
- Supplemental guidance on vessel sanitation and well-stored medical supplies.

Overall, safety of each cruise participant remained paramount. Thus, incorporated with the cruise practices into epidemic prevention and control, a robust set of strengthened pre-cruise protocols were carefully executed as following:

- Developed 14-day Health Declaration Archives.
- Conducted required COVID-19 testing.
- Invited experts in disease control to provide proper training.


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On April 15, based on a thorough risk assessment and prudent pre-cruise preparation, Marine Operations (XMU) resumed seagoing operations of R/V TKK, being China's first academic institution returning to operations during the COVID-19 pandemic. A ship-to-shore cruise emergency drill was jointly conducted in nearshore Xiamen Bay onboard R/V TKK, cooperated with Donghai No.2 Flying Service of Ministry of Transport and Xiang'an Hospital of Xiamen University. This drill was an important precautionary measure to test whether the emergency plans were operationally feasible and responsive to the issues likely to arise onboard.

Epidemic prevention and control measures were strictly implemented during all cruises throughout the year, and all 301 cruise participants accomplished their expeditions and returned safe and sound.

# 基金委共享航次
# NSFC Open Research Cruise (NORC)

2020 年，“嘉庚”号分三个航次圆满完成“国家自然科学基金共享航次计划 2018 年度和 2019 年度南海中部海盆科学考察实验研究 (NORC2019-06 和 NORC2020-06)”调查任务，合计航次作业 111 天，为来自 13 家科研单位的 53 个基金项目提供宝贵的基础数据和样品。

**In 2020, three NORC cruises (KK2001, KK2002 and KK2004) were implemented onboard R/V TKK in the central SCS (NORC2019-06 and NORC2020-06). These cruises supported 53 NFSC-funded projects from 13 institutions and obtained valuable data and samples, with a total of 111 operational days at sea.**


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# 基金委南海中部海盆共享航次
# 2018 年度水文生化航次
# Comprehensive Biogeochemical Cruise in central SCS (NORC2019-06)

航次编号：KK2001
首席科学家：厦门大学 郭香会副教授
航期：4 月 15 日 — 5 月 21 日，为期 39 天（海上作业 37 天）
航程：约 4700 海里
参航人员：厦门大学、中国科学院南海海洋研究所共 23 名科研人员
Cruise ID: KK2001
Chief Scientist: Xianghui Guo, Associate Professor of XMU
Duration: 39 days (April 15-May 21), with 37 days at-sea operations
Range: 4,700 nautical miles
Participants: 23 scientists from XMU and South China Sea Institute of Oceanology, China Academy of Sciences (SCSIO)

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4 月 15 日至 5 月 21 日，“嘉庚”号圆满完成“国家自然科学基金共享航次计划 2018 年度南海中部海盆科学考察实验研究（NORC2019-06）”水文生化航次科学考察任务。航次共搭载基金委项目 13 个，航程约 4700 海里。厦门大学郭香会副教授任首席科学家。

航次于南海中部作业海区共完成 CTD cast 162 次，湍流剖面仪观测 137 次，多层生物拖网 20 次，大体积泵 11 次，布放潜标 3 套，回收潜标 4 套。其中，CTD 累计采水量达 4.38 万升。

5 月 20 日，返航途经赤潮影响外边缘的“嘉庚”号，临时加入在福建近海开展“有害赤潮同步观测和预警预报研究”的百人科研团队，历时 7 小时在厦门湾外断面进行了 6 个站位的 CTD 采样作业。

From April 15 to May 21, the comprehensive biogeochemical cruise in the central SCS (NORC2019-06) was accomplished onboard R/V TKK. This cruise supported 13 NSFC-funded projects along a survey track of 4,700 nautical miles. Xianghui Guo, Associate Professor of XMU, was the chief scientist.

Operations conducted: 162 CTD casts, 137 turbulence profiling, 20 multi-net plankton sampling, 11 in-situ LVPs, 3 mooring deployments, and 4 mooring recoveries, with 43,800 liters water samples collected.

On May 20, more than 100 researchers carried out a multi-ship monitoring of a harmful algal bloom event in the coastal waters of Fujian. Research groups onboard R/V TKK accidentally joined this campaign en route the inbound of KK2001 cruise. Six stations were occupied during 7-hour operations at Xiamen Bay.

# 基金委南海中部海盆共享航次
# 2018 年度和 2019 年度地质地球物理航次
# Geological and Geophysical Cruise in central SCS (NORC2019-06 and NORC2020-06)

航次编号：KK2002
首席科学家：中国科学院南海海洋研究所 王彦林助理研究员
航期：5 月 27 日— 6 月 28 日，为期 33 天（海上作业 26 天）
航程：约 3200 海里
参航人员：厦门大学、中国科学院南海海洋研究所、中国科学院海洋研究所等单位共 28 名科研人员
Cruise ID: KK2002
Chief Scientist: Dr. Yanlin Wang, Research Associate of SCSIO
Duration: 33 days (May 27-June 28), with 26 days at-sea operations
Range: 3,200 nautical miles
Participants: 28 scientists from XMU, SCSIO and Institute of Oceanology, Chinese Academy of Sciences (IOCAS)

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6 月 1 日至 6 月 26 日，“嘉庚”号圆满完成“国家自然科学基金共享航次计划 2018 年度和 2019 年度南海中部海盆科学考察实验研究（NORC2019-06 和 NORC2020-06）”地质地球物理航次科考任务。航次搭载基金委项目 22 个，国内共 11 家单位的 28 名科研人员参航。中国科学院南海海洋研究所王彦林博士任首席科学家。

航次共实施 300 海里地球物理测线调查，完成 86 个站位作业，成功获取了抓斗沉积物 32 斗，箱式沉积物 15 斗，重力柱状沉积物 27 个，浮游生物拖网 10 次，底栖生物拖网 7 次，热流探针作业 21 次，海底摄像 7 次。

海底泥火山调查是航次的重点调查任务之一。通过船载多波束探测系统和浅地层剖面仪等走航调查设备，航次在南海北部东沙群岛海区采集了大量相关数据，发现了泥火山、海底麻坑和气体羽等油气泄露的地球物理证据，并采获大量碳酸盐岩结核和冷水珊瑚等油气泄露的沉积和生物证据，显示了较高的生物多样性。航次首席科学家王彦林博士表示，海底泥火山调查充分体现了海洋地球物理、海洋地质和海洋生物等多学科的交叉与合作，是本航次工作的一个亮点。

From June 1 to June 26, the geological and geophysical cruise in the central SCS (NORC2019-06 and NORC2020-06) was successfully accomplished onboard R/V TKK. The cruise supported 22 NSFC-funded projects, and 28 scientific researchers from 11 domestic institutions. Dr. Yanlin Wang from SCSIO served as chief scientist.

Over 300 nautical miles geographical survey lines were implemented. In addition, there were 32 grab sediment samples, 15 box cores, 27 gravity cores, 10 plankton trawls, 7 benthic trawls, 21 heat flow probes, and 7 underwater photography operations conducted at 86 stations.

Submarine mud volcano is one of the key survey missions during the KK2002 cruise. With the ship-borne multi-beam seafloor mapping system and sub-bottom profiler, abundant geophysical, sedimentary and biological evidence of oil and gas leakage, such as mud volcanic vents and gas plumes, a large number of carbonate chimneys/nodules and cold-water corals, were found in the Dongsha area. Dr. Yanlin Wang pointed out that the submarine mud volcano was a highlight of this cruise. It fully embodied the interdisciplinary cooperation of marine geophysics, geology, and biology.

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# 基金委南海中部海盆共享航次
# 2019 年度水文生化航次
# Comprehensive Biogeochemical Cruise in central SCS (NORC2020-06)

航次编号：KK2004
首席科学家：厦门大学 唐甜甜副教授
航期：8 月 23 日— 10 月 1 日，为期 40 天（海上作业 30 天）
航程：约 3809 海里
参航人员：厦门大学、中国科学院青岛生物能源与过程研究所、中国海洋大学、中国科学院海洋研究所等 28 名科研人员
Cruise ID: KK2004
Chief Scientist: Tiantian Tang, Associate Professor of XMU
Duration: 40 days (August 23-October 1), with 30 days at-sea operations
Range: 3,809 nautical miles
Participants: 28 scientists from XMU, IOCAS, Qingdao Institute of Bioenergy and Bioprocess Technology, Chinese Academy of Sciences (QIBEBT) and Ocean University of China (OUC)

8 月 30 日至 9 月 30 日，“嘉庚”号圆满完成“国家自然科学基金共享航次计划 2019 年度南海中部海盆科学考察实验研究（NORC2020-06）”水文生化航次科考任务。航次搭载来自厦门大学、中国科学院青岛生物能源与过程研究所、中国海洋大学等 4 家单位共 18 个基金项目，累计参航人员 28 人。厦门大学唐甜甜副教授任航次首席科学家。

航次共完成 33 个 CTD 站位累计 167 次 CTD 采水作业，39 次拖网作业，11 次大体积泵作业。在饱受台风“红霞”之苦避风 4 天的情况下，针对南海中部海盆区域开展了全面的综合性大面调查，保质保量完成计划内作业内容，积累了大量观测数据。特别值得一提的是，本航次还对北纬 12° 以南的南部海区进行了观测，获得珍贵的水文和物种分布资料。

From August 30 to September 30, the comprehensive biogeochemical cruise in the central SCS (NORC2020-06) was accomplished onboard R/V TKK. This cruise supported 18 NSFC-funded projects and 28 scientists from four institutions. Tiantian Tang, Associate Professor of XMU, served as the chief scientist of this cruise.

Totally there were 167 CTD casts, 39 trawls, and 11 in-situ LVPs implemented at 33 stations during the cruise. Despite the influence of the typhoon “Noul”, a comprehensive survey was successfully carried out in the central SCS basin, and valuable data were collected.

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# 泥火山
# Mud Volcano

泥火山在全球很多地方都有分布，目前陆地上已经超过 40 个地区，海底已超过 20 个海域。

海底泥火山也称海底泥丘，呈圆丘状凸起于周边海底，它是含气泥质流体喷发至海底形成的地质构造，喷溢物通常包含大量地下气体（甲烷、其它烷烃、$CO_2$、$H_2S$、$N_2$ 等）、泥浆、盐水、石油及深部地层岩碎。泥火山典型特征是海山周围环边凹陷，顶部为漏斗状喷口和通向深部的流体通道，海底漏气、发育碳酸盐岩结核和物种丰富的化能“黑暗生物圈”。

作为海底泥火山中的一种类型，油气型泥火山是含油气泥质流体的喷发，它不仅是了解深部地质构造运动的窗口，而且可以指示深部油气藏的存在。另外，喷溢的甲烷气体可以在深海形成水合物，供养化养生物并形成深海生物礁，余者泄入海水和大气，故而海底油气型泥火山的探测与研究具有重要的地质、生物、环境科学意义和资源价值。

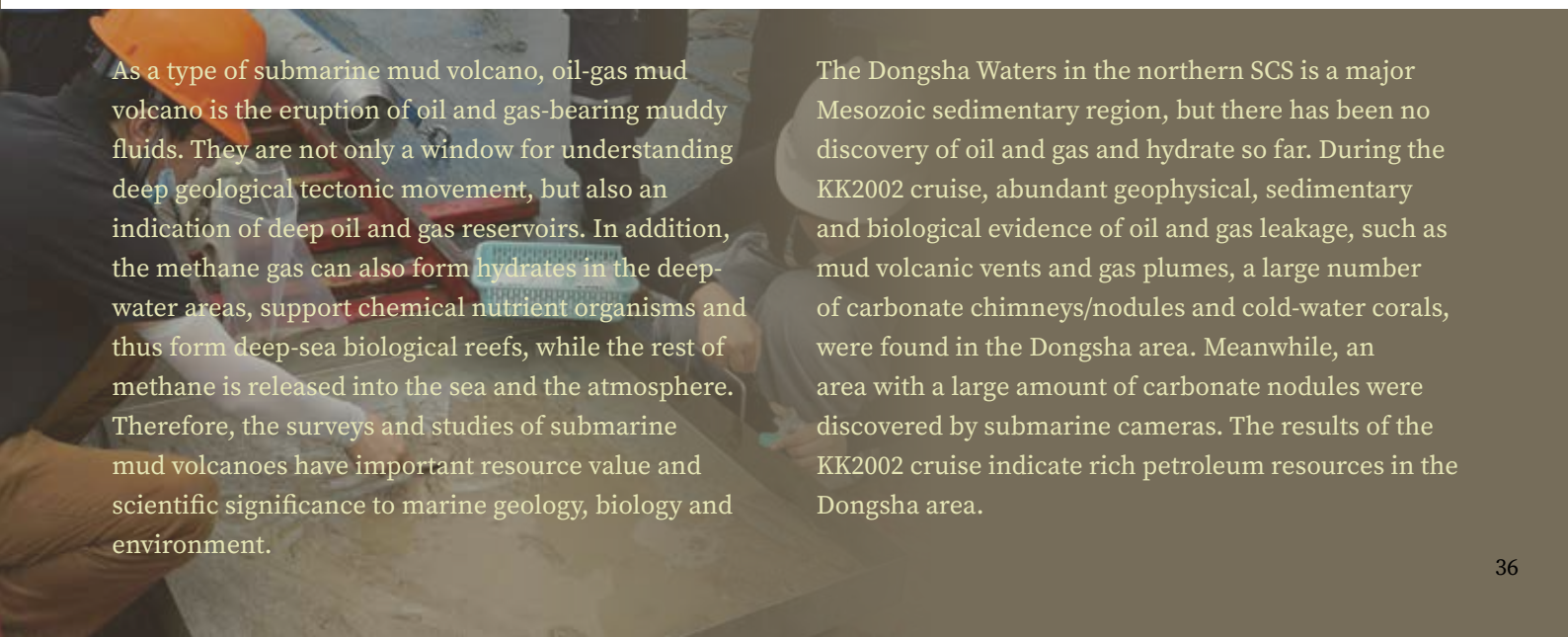
南海北部东沙群岛海区一直未有油气和水合物发现，是我国南海油气勘探亟待突破区。KK2002 航次在该海区发现了泥火山喷口和气体羽等油气泄露的地球物理证据，采获了大量碳酸盐岩结核和冷水珊瑚等油气泄露的沉积和生物证据，海底摄像还发现了大范围的碳酸盐岩结核，这不仅充分说明南海北部东沙群岛海区发育的海山与油气泄露密切相关，而且预示东沙群岛海区丰富的油气资源。

Mud volcanoes widely distribute in the basin areas of high sedimentation rate and lateral tectonic compression. Mud volcanoes are documented at more than 40 onshore locations and more than 20 offshore locations worldwide, and the number of mud volcanoes in the onshore and the shallow water areas is more than 2000.

Submarine mud volcanoes are mound-like geological structures deeply rooted into the subsurface seafloor. They are formed by the eruption and associated transport of warm, deep-sourced gas-bearing muddy fluids. The effusive material usually contains a large amount of gas from below the Earth's surface (methane, other alkanes, carbon dioxide, sulfuretted hydrogen, nitrogen gas and etc.), mud, liquids (e.g., salts and minerals in the water), oil and rock fragment from deep strata. The typical features of submarine mud volcano are rim depression circling seamount, top funnel-shaped vent and the fluid channel, gas leakage, the development of carbonate chimney/crust/nodule, and species-rich chemical energy "dark biosphere".

## NORC2019-06 水文生化航次搭载项目列表（KK2001 航次）

| 序号 | 项目批准号 | 项目名称 | 项目负责人 | 单位名称 | 项目类型 |
|---|---|---|---|---|---|
| 1 | 41630970 | 南海内潮演变特征及湍流混合机制研究 | 尚晓东 | 中国科学院南海海洋研究所 | 重点 |
| 2 | 41706029 | 基于微结构观测的 Thorpe 尺度方法的适用性研究 | 岑显荣 | 中国科学院南海海洋研究所 | 青年 |
| 3 | 41606010 | 海洋温盐台阶动力过程的实验室模拟 | 屈玲 | 中国科学院南海海洋研究所 | 青年 |
| 4 | 41476061 | 南海上层水体黑碳颗粒动力学的同位素示踪 | 杨伟锋 | 厦门大学 | 面上 |
| 5 | 41775133 | 大气有机酸多相反应对颗粒物通过凝华核化形成冰晶性能的影响 | 汪冰冰 | 厦门大学 | 面上 |
| 6 | 31772426 | 基于多来源数据重建固着目（纤毛门，寡膜纲，缘毛亚纲）内部系统发育关系 | 孙萍 | 厦门大学 | 面上 |
| 7 | 41876083 | 利用光谱与超高分辨率质谱表征南海—吕宋海峡—西菲律宾海地溶解有机质循环 | 郭卫东 | 厦门大学 | 面上 |
| 8 | 41703070 | 利用氨基酸稳定同位素技术评估蓝细菌及其降解产物在颗粒有机物中的相对贡献 | 唐甜甜 | 厦门大学 | 青年 |
| 9 | 41706160 | 南海浮游植物光适应参数的时空分布、调控因子及遥感反演 | 谢聿原 | 厦门大学 | 青年 |
| 10 | 41306125 | 福建沿海砂壳纤毛虫壳体多态性及分子系统学研究 | 徐大鹏 | 厦门大学 | 青年 |
| 11 | 91428308 | 南海碳循环与生物学储碳机制集成研究 | 焦念志 | 厦门大学 | 重点 |
| 12 | 41606113 | 沿海三维声层析研究 | 张传正 | 自然资源部第二海洋研究所 | 青年 |
| 13 | 41776034 | 南海西北陆架垂向环流动力诊断及其季节变化 | 谢玲玲 | 广东海洋大学 | 面上 |



As a type of submarine mud volcano, oil-gas mud volcano is the eruption of oil and gas-bearing muddy fluids. They are not only a window for understanding deep geological tectonic movement, but also an indication of deep oil and gas reservoirs. In addition, the methane gas can also form hydrates in the deep-water areas, support chemical nutrient organisms and thus form deep-sea biological reefs, while the rest of methane is released into the sea and the atmosphere. Therefore, the surveys and studies of submarine mud volcanoes have important resource value and scientific significance to marine geology, biology and environment.

The Dongsha Waters in the northern SCS is a major Mesozoic sedimentary region, but there has been no discovery of oil and gas and hydrate so far. During the KK2002 cruise, abundant geophysical, sedimentary and biological evidence of oil and gas leakage, such as mud volcanic vents and gas plumes, a large number of carbonate chimneys/nodules and cold-water corals, were found in the Dongsha area. Meanwhile, an area with a large amount of carbonate nodules were discovered by submarine cameras. The results of the KK2002 cruise indicate rich petroleum resources in the Dongsha area.

## NORC2019-06 和 NORC2020-06 地质地球物理航次搭载项目列表（KK2002 航次）

| 序号 | 项目批准号 | 项目名称 | 项目负责人 | 单位名称 | 项目类型 |
|---|---|---|---|---|---|
| 1 | 41776093 | 五株海绵共附生真菌抗橡胶炭疽病菌的化学成分研究 | 曾艳波 | 中国热带农业科学院热带生物技术研究所 | 面上 |
| 2 | 41773039 | 用拉曼光谱研究中低成熟度有机质的成熟度演化 | 靳永斌 | 中国科学院南海海洋研究所 | 面上 |
| 3 | 41876052 | 南海西南次海盆疑似蛇纹石泥火山研究—以龙门海山为例 | 王彦林 | 中国科学院南海海洋研究所 | 面上 |
| 4 | 41706163 | 菲律宾海盆线虫群落结构与生物多样性特征 | 史本泽 | 中国科学院海洋研究所 | 青年 |
| 5 | 41606070 | 琼东和粤西上升流区沉积物长链烯酮和GDGTs 的分布及对海表温度的重建 | 孔德明 | 广东海洋大学 | 青年 |
| 6 | 41874099 | 断裂带同震温度异常机制—以集集、汶川及日本东北地震为例 | 杨小秋 | 中国科学院南海海洋研究所 | 面上 |
| 7 | 41706065 | 基于地震勘探资料的南海北部陆坡区土力学性质反演及边坡稳定性评价 | 刘杰 | 自然资源部第一海洋研究所 | 青年 |
| 8 | 41676146 | 南海北部自由生活线虫分类和多样性研究 | 黄勇 | 聊城大学 | 面上 |
| 9 | 41706163 | 菲律宾海盆线虫群落结构与生物多样性特征 | 史本泽 | 中国科学院海洋研究所 | 青年 |
| 10 | 41876052 | 南海西南次海盆疑似蛇纹石泥火山研究—以龙门海山为例 | 王彦林 | 中国科学院南海海洋研究所 | 面上 |
| 11 | 91855101 | 南沙腹地隐伏背斜构造的成因及对古南海的指示 | 阎贫 | 中国科学院南海海洋研究所 | 重大计划 |
| 12 | 41773039 | 用拉曼光谱研究中低成熟度有机质的成熟度演化 | 靳永斌 | 中国科学院南海海洋研究所 | 面上 |
| 13 | 41876180 | 中国海巨螅类分类学与分子系统学研究 | 宋希坤 | 厦门大学 | 面上 |
| 14 | 41772010 | 华南寒武系水母化石分异度和谱系研究 | 韩健 | 西北大学 | 青年 |
| 15 | 41776088 | CFCs + SF6 示踪法研究南海北部人为碳储量变化及其影响因素 | 柯宏伟 | 厦门大学 | 面上 |
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| 17 | 41706071 | 南海现代砗磲壳体高分辨率元素地球化学记录及其对南海表层碳酸盐系统的指示意义 | 马小林 | 中国科学院地球环境研究所 | 青年 |
| 18 | 41877399 | 利用砗磲重建南海北部小时分辨率气候变化初探 | 晏宏 | 中国科学院地球环境研究所 | 面上 |
| 19 | 41776078 | 南海北部陆缘异常构造沉降形成机制与破裂阶段热状态的数值模拟 | 施小斌 | 中国科学院南海海洋研究所 | 面上 |
| 20 | 51879035 | 基于饱和海洋黏土流固耦合方法的张紧式组合吸力锚承载 特性研究 | 王胤 | 大连理工大学 | 面上 |
| 21 | 41874099 | 断裂带同震温度异常机制—以集集、汶川及日本东北地震为例 | 杨小秋 | 中国科学院南海海洋研究所 | 面上 |
| 22 | 41876178 | 基于多种基因的十足目（节肢动物门: 软甲纲）总科间系统发育关系 研究 | 李新正 | 中国科学院海洋研究所 | 面上 |

# NORC2020-06 水文生化航次搭载项目列表（KK2004 航次）

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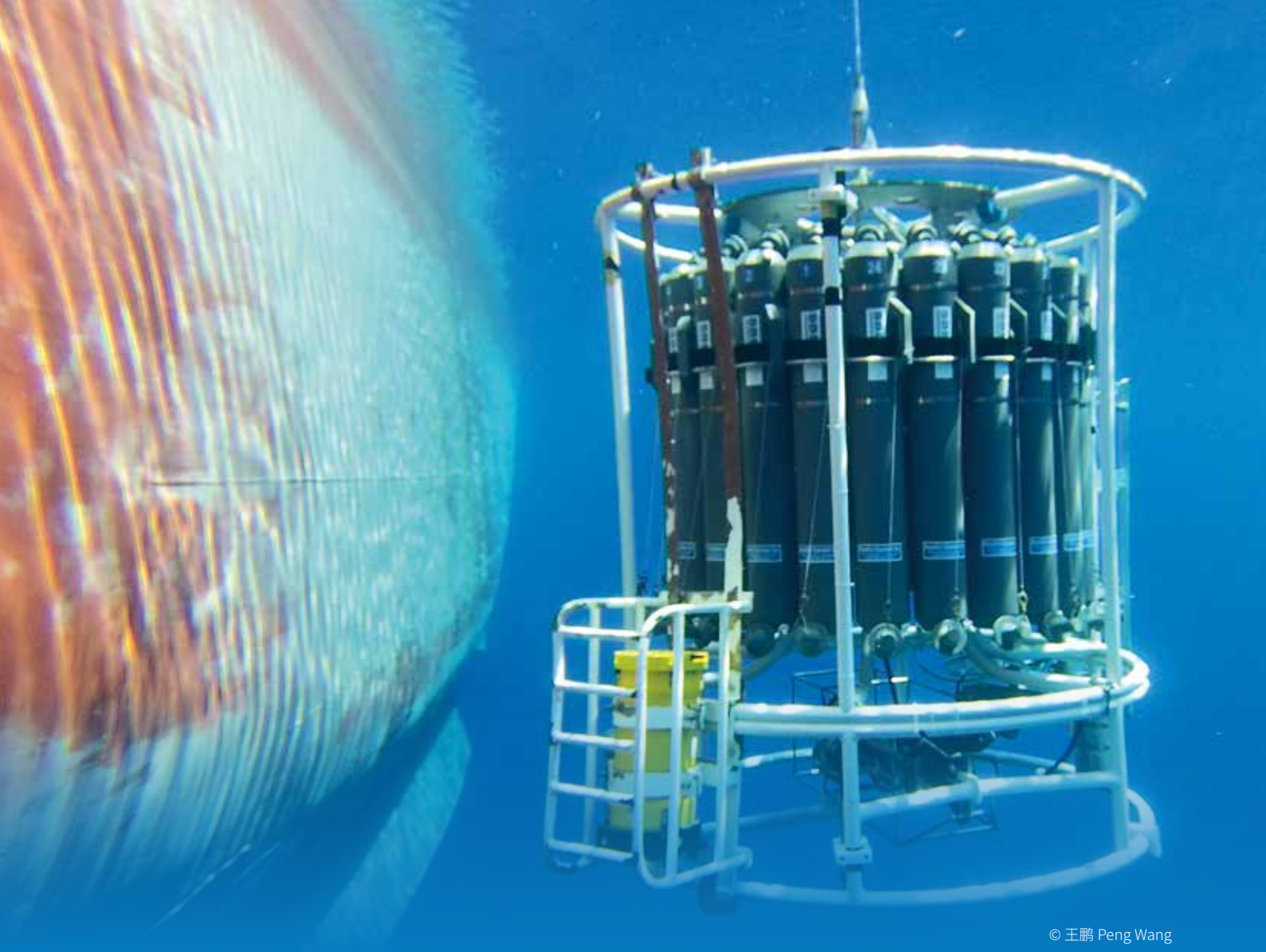
| 1 | 41676059 | 黑潮溶解有机碳入侵南海北部的交换过程与降解机制研究 | 李骁麟 | 厦门大学 | 面上 |
| 2 | 41776146 | 南海北部浮游植物群落初级生产关键参数间的定量关系及其影响因素 | 柳欣 | 厦门大学 | 面上 |
| 3 | 41876142 | 南海典型环境浮游原生生物分子生态学研究 | 徐大鹏 | 厦门大学 | 面上 |
| 4 | 41876081 | 南海海盆陆源颗粒大气沉降通量的长寿命 Th 同位素示踪 | 蔡毅华 | 厦门大学 | 面上 |
| 5 | 41706116 | 浮游植物中非典型碱性磷酸酶 PhoAaty 表达模式和酶学特 性的研究 | 林昕 | 厦门大学 | 青年 |
| 6 | 41706139 | 低温胁迫下血红哈卡藻的细胞程序性死亡研究 | 黄晓舟 | 泉州师范学院 | 青年 |
| 7 | 31772426 | 基于多来源数据重建固着目（纤毛门、寡膜纲、缘毛亚纲）内部系统发育关系 | 孙萍 | 厦门大学 | 面上 |
| 8 | 41776086 | 我国近海至西北太平洋大气中氨和有机胺浓度特征及其 在不同粒径颗粒上竞争中和酸性成分机制的研究 | 姚小红 | 中国海洋大学 | 面上 |
| 9 | 41776184 | SBA 系统自阴影效应及其校正方法研究 | 李忠平 | 厦门大学 | 面上 |
| 10 | 31750001 | 中国孢子植物志的编研 | 庄文颖 | 中国海洋大学 | 应急管理项目 |
| 11 | 31700425 | 胶州湾浮游植物碳输出通量的季节变化和影响因子研究 | 郭术津 | 中国科学院海洋研究所 | 青年 |
| 12 | 41775133 | 大气有机酸多相反应对颗粒物通过凝华核化形成冰晶性能的影响 | 汪冰冰 | 厦门大学 | 面上 |
| 13 | 41703070 | 利用氨基酸稳定同位素技术评估蓝细菌及其降解产物在颗粒有机物中的相对贡献 | 唐甜甜 | 厦门大学 | 青年 |
| 14 | 41876080 | 珠江口水体酸化与缺氧的耦合机制 | 郭香会 | 厦门大学 | 面上 |
| 15 | 41676125 | 南海氨氧化与亚硝酸盐氧化功能群的耦联关系及其所介导的碳氮耦合过程研究 | 张瑶 | 厦门大学 | 面上 |
| 16 | 41876174 | 黄海典型近海养殖沉积物中病毒生态特性与生存策略研究 | 张永雨 | 中国科学院青岛生物能源与过程研究所 | 面上 |
| 17 | 41806172 | 一株深海来源硅藻 Chaetoceros sp. DS1 耐受长期低温和黑暗条件下的调控机制研究 | 牟善莉 | 中国科学院青岛生物能源与过程研究所 | 青年 |
| 18 | 41606153 | 南海海盆区典型站位浮游病毒与主要宿主类群关系的研究 | 梁彦韬 | 中国科学院青岛生物能源与过程研究所 | 青年 |



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# Carbon-FE 夏季西太平洋科考航次
# Carbon-FE northwestern Pacific Cruise in summer

航次编号：KK2003
首席科学家：厦门大学 柳欣副教授
海域：西太平洋
航期：6 月 29 日— 8 月 22 日，为期 55 天（海上作业 51 天）
航程：约 7476 海里
参航人员：来自厦门大学、中国海洋大学、上海交通大学、中国科学院海洋研究所等科研单位的 36 名科研人员
Cruise ID: KK2003
Chief Scientist: Xin Liu, Associate Professor of XMU
Location: northwestern Pacific
Duration: 55 days (June 29-August 22), with 51 days at-sea operations
Range: 7,476 nautical miles
Participants: 36 scientists from XMU, OUC, IOCAS and Shanghai Jiao Tong University


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8 月 22 日，由厦门大学领衔的国家自然科学基金重大项目“海洋荒漠生物泵固碳机理及增汇潜力”（Carbon Fixation and Export in the oligotrophic ocean, Carbon-FE）夏季西太平洋科考航次（KK2003）在“嘉庚”号上顺利完成。航次搭载来自厦门大学、中国海洋大学、上海交通大学、中国科学院海洋研究所等科研单位的 36 名科研人员，围绕海洋大气、水文、生地化和痕量金属等多学科科学问题，在西太平洋海域开展综合断面调查和样品采集。

通过多平台、多仪器同步观测与采样，航次于 51 天的海上作业时间内共计完成痕量金属洁净 CTD 采水、原位大体泵采样、沉积物捕获器布放和回收、浮游生物垂直分层拖网、光学剖面仪和 BGC-Argo 剖面漂流浮标的布放等研究内容近 400 项。

本航次再次获得国际 GEOTRACES（痕量元素和同位素海洋生物地球化学循环）研究计划认证，成为继 2019 年 GEOTRACES-CHINA 西太断面调查航次（编号 GP09, KK1903）后，由厦门大学主导、“嘉庚”号执行的第二次该计划认证航次，认证编号为 GPpr15。

航次中，厦门大学痕量研究团队共完成 22 个站位的科考作业，包括 5 个痕量重点洁净站位、10 个痕量常规洁净站位、3 个水文站位和 4 个走航重点站位。累计开展痕量洁净采水作业（TMC CTD）29 次，最大采水深度 5796 米。为提升采样空间覆盖率，全程开启船载声学多普勒剖面仪（OS 38 型和 WHM 300 型 ADCP）、走航表层温、盐观测系统（SBE 21）、船载气象站（AWS）等水文气象走航设备，并增加 MVP300 沿观测断面进行多参数剖面观测。其中，MVP300 共完成测线作业 17 条次，采集剖面数据 1120 个，测线总里程 2500 海里。

在“嘉庚”号超洁净痕量元素专用采水系统（Trace Elements and Isotopes Sampling System, TEISS）的支持下，厦门大学已先后完成 4 个痕量航次，包括两个痕量设备海试航次（KK1703 航次和 KK1802 航次），以及两个 GEOTRACES 认证航次（KK1903 GP09 航次和 KK2003 GPpr15 航次）。目前，厦门大学已于 2019 年 12 月向国际 GEOTRACES 项目组提交了 KK1903 GP09 航次研究报告 https://www.bodc.ac.uk/geotraces/data/inventories/。后相关研究正在有序开展中。

KK2003 航次于 7 月 3 日启航 8 月 21 日靠港，累计海上作业 51 天，航程超 7000 海里，创“嘉庚”号运行以来单次航行最长纪录。

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On August 22, Carbon-FE northwestern Pacific Cruise in summer was successfully implemented onboard R/V TKK. Thirty-six scientists from four domestic research institutions participated in this cruise. Scientists conducted transactional surveys and collected various samples to tackle the scientific questions for ocean-atmosphere interaction, hydrography, biogeochemistry and trace metals in the northwestern Pacific, an oligotrophic "desert" in the ocean.

During the 51-day cruise, nearly 400 over-the-side operations were conducted with multi-platform observations and sampling, including trace metal clean CTD rosettes, in-situ pumps, sediment trap deployments, plankton vertical trawls, optical profiler and BGC-Argo float deployments.

This was the second international cruise endorsed as GEOTRACES Process Study and was coded as GPpr15.

Twenty-two stations were investigated during the cruise, including five key TEISS stations, ten regular TEISS stations, three hydrological stations and four key underway stations. Twenty-nine TMC CTD casts were implemented, with the deepest sampling at 5,796 meters. The underway equipment such as ADCP, SBE 21, MVP300 and automatic weather station (AWS) were intensively utilized. Additionally, survey data were obtained by MVP300 out of 1,120 profiles along a survey track of 2,500 nautical miles.

Equipped with the reliable Trace Element and Isotopes Sampling System (TEISS) onboard R/V TKK, four trace element cruises have been successfully accomplished by XMU, including two sea trials of trace element equipment and two GEOTRACES-endorsed cruises. Moreover, GEOTRACES-CHINA GP09 wNP Section Study Cruise Report has been available since December 2019 on the GEOTRACES website: https://www.bodc.ac.uk/geotraces/data/inventories/.

During this cruise, R/V TKK sailed more than 7,000 nautical miles, being the longest single cruise since her delivery.

KK2003

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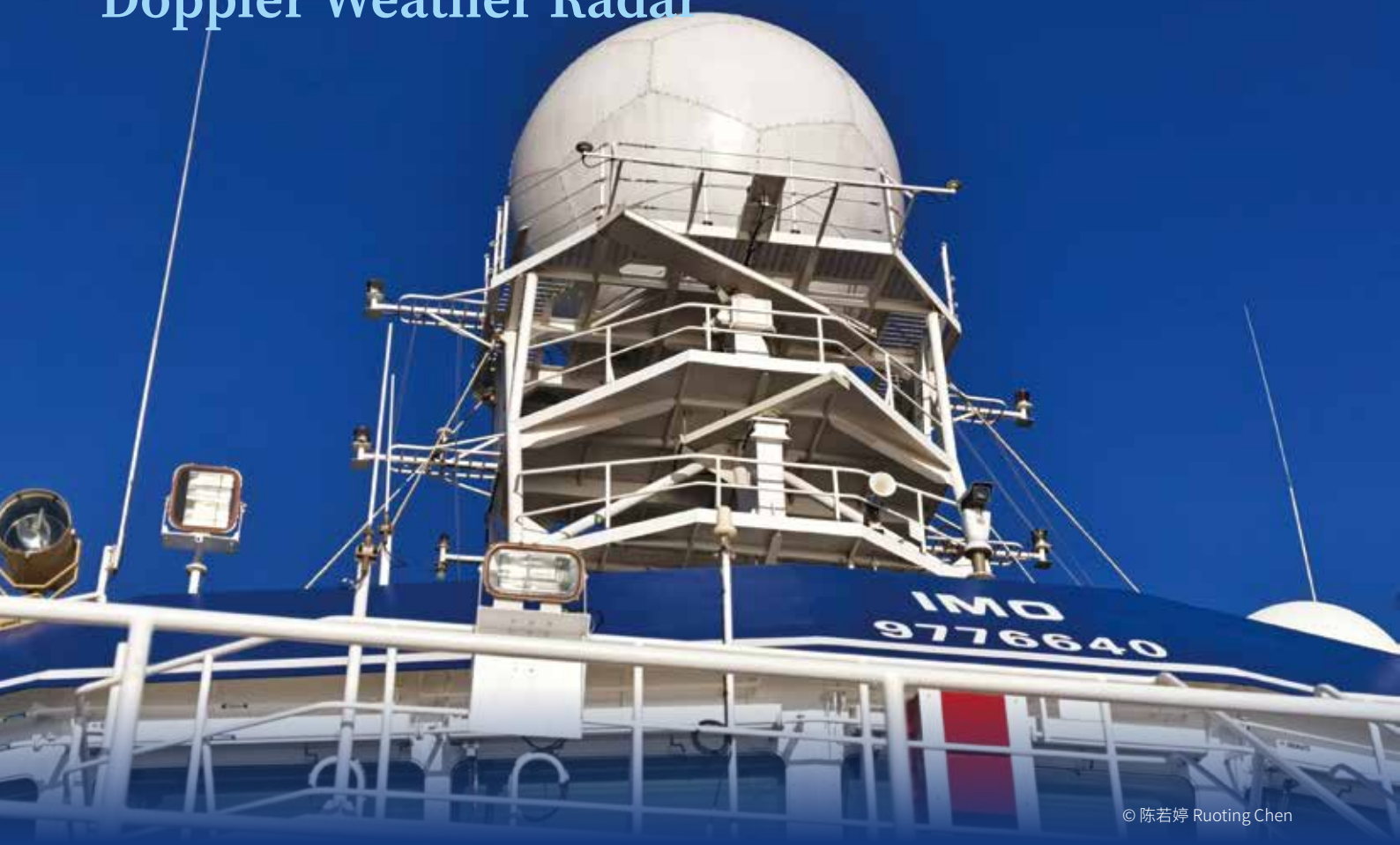
# 多普勒天气雷达
# Doppler Weather Radar

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2020 年伊始，一套新装备的入列让“嘉庚”号科考船看上去有了很大的不同。这套新装备就是位于“嘉庚”号科考船主雷达桅杆顶端的船载 C 波段双偏振多普勒天气雷达（以下简称“天气雷达”）。

古语云：工欲善其事，必先利其器。天气雷达正是科考船海上航行及海洋与大气科考作业的神兵利器之一。“嘉庚”号科考船的天气雷达作为主动式微波大气遥感设备，是中小尺度天气的主要探测工具之一。不仅能够获取科考船为中心 150 千米半径及海面上空 20 千米范围内的云、雨等天气目标的雷达回波信息，并对 400 千米半径范围内天气目标的强度及位置的实时监测和预测，为船舶航行路线及科考作业站位提供参考和预警；而且可以精确获取降水区中风场分布，准确提供流场分布信息和动态结构、以及降水率、冰雹含量、冰雹和雨滴大小及降水相态等信息，有助于科学家更深入地了解海上的降水机制。该系统获取的数据资料有望用于改善气候模型和天气预报。

本型号天气雷达的工作波段为 C 波段（波长 3.75 ～ 7.5 厘米），常用于大气降水探测。该雷达发射并接收水平和垂直两种偏振方式的微波脉冲，因此称为双偏振多普勒天气雷达。雷达射出的无线电波遇到雨滴、冰晶、雪花等会发生的散射，返回的电磁波被雷达天线所接收并通过一定的算法处理后形成回波图，分析可获得雨滴、冰雹、冰晶和雪的大小、数量、形状以及运动状态信息。科学家即可了解到一定范围内大气中降水的强度、分布和演变情况。

尽管从外表上看，天气雷达呈圆球形，但圆球并非天气雷达的“本体”，而是保障雷达系统全天候正常运转的天线罩。深入天线罩内部，才能见到天气雷达的雷达主机、稳定平台、伺服分机和配电分机。除上述位于雷达桅的组件外，天气雷达各功能的实现还有赖于隐藏在电子实验室的雷达控制终端及相应的信号处理、IQ 存储单元、数据处理和显示终端等组件的协同运转。

At the beginning of 2020, a newly-installed equipment, the impressive large soccer ball shaped object on the top of the central mast of R/V TKK, makes the ship look quite different. It is the C-band dual-polarization Doppler weather radar.

Confucius, the paragon of Chinese philosophers, once said, "A craftsman must sharpen his tools to do his job." The Doppler weather radar on R/V TKK serves as an essential and powerful weather observation system for atmospheric and marine scientific research. Featuring an active microwave atmospheric remote sensor, the weather radar plays a vital role in the observation of mesoscale weather system. It is capable of obtaining radar echoes from the meteorological targets such as clouds and rain within a radius of 150 kilometers from the vessel and 20 kilometers over the ocean. It also can provide real-time observation such as the intensity and location of meteorological targets within a radius of 400 kilometers radius from the ship, providing references in choosing navigation routes and scientific research stations. The precipitation distribution, the wind profile, and their dynamic structures, as well as other precipitation estimates can also be inferred by the radar. This helps scientists to gain better understanding in precipitation mechanisms. The data can be used to improve climate models and weather predictions.


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The Doppler weather radar hosted onboard R/V TKK works at C-band range (wavelength 3.75 ~ 7.5 centimeters) and is often used for precipitation measurements. It sends and receives microwave pulses. The pulse has vertical and horizontal signals, called dual polarization. The emitted radio waves are normally scattered by raindrops, ice crystals, snowflakes and other particles in the atmosphere. Then the reflected electromagnetic waves are received by the radar's antenna and processed by designed algorithms to eventually produce an echogram. The returning signal reveals the information on the number, size, shape, and movement of rain, hail, ice and snow. This helps scientists to understand the intensity, distribution, and evolution of precipitation.

Doppler weather radar is mounted atop the vessel's main mast within a protective radome that is designed to guarantee all weather operations of the system. The radar transmitter, Stewart platform, servo processor, and power suppliers are all suited within the radome. In the central electronic lab, the control system of the radar along with signal processor, IQ archiving unit, data processing units and product visualization terminals are cooperatively operated to ensure the highest possible performance of the weather radar at sea.

# 嘉庚号海洋大讲堂
# Teacher at Sea onboard R/V TKK

“嘉庚号海洋大讲堂”是面向我国海洋基础教育的一项尝新计划。该计划由厦门大学科考船运行管理中心、厦门集美中学和厦门市青少年成长教育协会共同创意发起，于 2020 年 6 月在“嘉庚”号的 KK2002 航次中正式启动。

**“Teacher at Sea onboard R/V TKK” is an innovative attempt for China’s marine education. Jointly initiated by Marine Operations (XMU), Xiamen Jimei High School and Xiamen Youth Development and Education Association, the program was officially launched in June 2020 during the KK2002 cruise.”**

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百年前，校主陈嘉庚先生在集美创办航海、水产等专科学校，培养海洋专门人才。百年后，海洋强国战略依然是我国的一项重要国策。建设海洋强国，离不开人才与智力的支撑，而基础教育在其中发挥着尤其重要的作用。

“嘉庚号海洋大讲堂”计划，旨在借助“嘉庚”号科考船先进的平台与技术优势，创新我国海洋基础教育形式，把海洋教育课堂搬到祖国的海洋国土上。

按计划，每年将在“嘉庚”号的科考航次中安排一到两次机会，邀请厦门乃至全国的基础教育名师（以中学科学教师为主），全程随船参加海上科考并通过网络开展远程的海洋科学现场授课和科普。

6 月 15 日，“嘉庚号海洋大讲堂”的首场海上直播课在“嘉庚”号上开讲。集美中学高中部地理教师陈庆军是大讲堂的首个随船教师，也是首期海上网课的主讲教师。围绕主题“南海海洋生物和海底沉积物的探秘之旅”，陈老师带领集美中学及远在西北内陆的临夏回民中学学生近距离“参观”“嘉庚”号，身临其境地感受了海洋科学现场调查的方法和魅力，并远程连线互动。直播课得到基金委南海中部共享航次（KK2002）科学家团队的大力支持。45 分钟的网络课堂及系列科普报道的全网关注量超过 500 万。

6 月 17 日，央视新闻直播间以《大海上的“网课”科考船上的海洋大讲堂》为题，播报“嘉庚”号积极发挥平台优势，为我国海洋科教做贡献。

Over a century ago, Mr. Tan Kah Kee, the founding father of XMU, established professional schools in Navigation and Fisheries at his hometown Jimei, holding the view of "cultivating maritime professionals for China". Despite the pioneering contributions he had made to China's marine education, it still remains one of the major national policies in China to develop as a maritime power, which calls for the crucial role played by K-12 education.

By offering seagoing opportunities to participating teachers onboard the advanced platform such as R/V TKK, the program provides first-hand ocean science knowledge to K-12 students through this unique at-sea class, implementing a great transform from traditional teaching approaches on land.

Beginning in 2020, selected K-12 science teachers from all over the country will be invited to attend the "Teacher at Sea" program. They will take an expedition at sea onboard R/V TKK and offer live online courses about ocean science and technology.

"在这堂课上，我们就像真的踏上了'嘉庚'号，看到了许多从未见过的仪器设备。我很荣幸能向科学家提问，感觉科学家就在眼前！"

——集美中学首届"嘉庚班"陈艺铎同学


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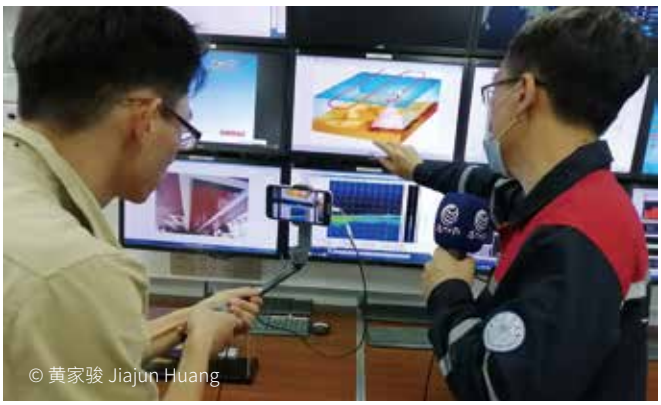
“通过这种连线互动的方式，同学们可以学到在课本和网络上了解不到的知识，大家已经期待这次活动很久了。如果条件允许，希望这种形式的教学可以多一些，让同学们多多接触海洋世界。”——临夏回民中学地理老师杨东旭

On June 15, 2020, the first “Teacher at Sea” online lecture was broadcast on R/V TKK with the theme “Adventure to Explore Marine Life and Sea-bottom Sediments in the SCS”. The lecture was given by Chen Qing-jun, a Geography teacher from Jimei High School. Mr. Chen took students from his school and those from Linxia Huimin Middle School in the remote northwestern inland Gansu Province, on an up-close virtual tour of R/V TKK, where they were able to immerse themselves in the approaches and fascination of ocean science field investigations and interactively communicate with each other online. Well supported by scientists of the NSFC Open Research Cruise in the SCS (NORC2020-06), the 45-minute lecture and its series of related media coverage attracted nearly five million online viewers.

On June 17, the news “Online Lectures Launched onboard R/V TKK” was broadcast by CCTV. It also reported that students and teachers were able to virtually explore this world-class research ship and reaped the benefits of the platform.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SWL 23K

本年度，中山大学三次来访厦门大学船管中心，就科考船运行、管理及合作等方面进行调研交流。

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## 8月

8 月 27 日，中山大学号下水之际，船管中心王海黎主任受邀参加“海洋科考高峰论坛”，并做“嘉庚”号运行与管理经验分享。

## 10月

10 月 20 日，由中国船舶第七〇八研究所、中国造船工程学会船舶设计专业委员会、上海市船舶与海洋工程学会联合主办的第二届海洋科学考察船技术高峰论坛在上海举行，船管中心主任王海黎参会，同与会者共同研讨科学考察船管理、使用、设计、监造等问题，并向业内同仁分享“嘉庚”号科考船的运行管理经验。

## 11月

11 月 25 日，福建省地震局党组书记、局长刘建达率队调研走访“嘉庚”号，并探讨交流相关合作事宜。

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## 12月

12 月 8 日，船管中心同索尼（中国）有限公司消费电子营业本部联合举办海洋科考摄影沙龙活动，与会嘉宾就海洋摄影及影像处理技术手段等进行了精彩的分享与互动展示。

## 12月

12 月 29 日，集美中学陈庆军名师工作室团队一行到访船管中心，就“嘉庚号海洋大讲堂”等科普活动事宜进行交流研讨。

# 成果产出一览表（201704-202101）

自 2017 年 4 月运行以来，“嘉庚”号共完成 29 个科考调查航次，累计为近千名海洋科研工作者提供船时服务和技术保障，有力支持了我国深远海的科学研究工作。为规范“嘉庚”号科研成果管理，从 2020 年起，我们将对依托“嘉庚”号平台产出的论文、著作、获奖等科研成果进行收集。欢迎各用船单位和用户提供相关信息。

下表所列成果检索自国内外各文献数据库，统计时间截至 2021 年 1 月 6 日，并将按年度持续更新。由于是人工检索和统计，难免会有疏漏和错误。如若发现，请及时联系我们更正。您的理解和支持对我们不断完善工作至关重要！

| 序号 | 论文标题、作者、刊名、时间 |
|---|---|
| 1 | Diel patterns of variable fluorescence and carbon fixation of picocyanobacteria Prochlorococcus-dominated phytoplankton in the South China Sea basin. Yuyuan Xie, Laws Edward A., Lei Yang, Bangqin Huang. FRONTIERS IN MICROBIOLOGY,2018, 9, 1589. IF:4.235, SCI2. |
| 2 | Automated spectrophotometric determination of carbonate ion concentration in seawater using a portable syringe pump based analyzer. Qipei Shangguan,Huilin Shu, Peicong Li, Kunning Lin, Byrne Robert H., Quanlong Li, Dongxing Yuan, Jian Ma. MARINE CHEMISTRY,2019, 209, 120-127.IF:2.933, SCI3. |
| 3 | Genomic, transcriptomic, and proteomic insights into the symbiosis of deep-sea tubeworm holobionts. Yi Yang, Jin Sun, Yanan Sun, Kwan Yick Hang, Wong Wai Chuen, Yanjie Zhang, Ting Xu , Dong Feng, Yu Zhang, Jianwen Qiu , Peiyuan Qian. THE ISME JOURNAL,2019, 1-16.IF:9.18,SCI1. |
| 4 | Bottom and intermediate nepheloid layer induced by shoaling internal solitary waves: impacts of the angle of the wave group velocity vector and slope gradients. Zhuangcai Tian, Yonggang Jia, Shaotong Zhang, Xiaojiang Zhang, Yang Li, Xiujun Guo. JOURNAL OF GEOPHYSICAL RESEARCH:OCEANS, 2019, 124 (8), 5686-5699.IF:3.559,SCI2. |
| 5 | Impacts of the Zhe-Min Coastal Current on the biogeographic pattern of microbial eukaryotic communities. Zhimeng Xu, Yifan Li, Yanhong Lu, Yingdong Li, Zhongwei Yuan, Minhan Dai, Hongbin Liu. PROGRESS IN OCEANOGRAPHY, 2020,183,102309.IF:4.06,SCI3. |
| 6 | Niche differentiation of sulfate-and iron-dependent anaerobic methane oxidation and methylotrophic methanogenesis in deep sea methane seeps. Haizhou Li, Qunhui Yang, Huaiyang Zhou. FRONTIERS IN MICROBIOLOGY, 2020, 11.IF:4.235, SCI2. |
| 7 | Partial pressure of CO2 and air-sea CO2 fluxes in the South China Sea: Synthesis of an 18-year dataset. Qian Lia, Xianghui Guo,Weidong Zhai, Yi Xu, Minhan Dai. PROGRESS IN OCEANOGRAPHY, 2020, 182, 102272.IF:4.06,SCI3. |
| 8 | Ecological characterization of cold-seep epifauna in the South China Sea. Yu Zhao, Ting Xu, Yu Sheung Law, Dong Feng, Jianwen Qiu. DEEP SEA RESEARCH PART I: OCEANOGRAPHIC RESEARCH PAPERS 2020, 163, 103361.IF:2.606,SCI2. |
| 9 | Impacts of the Zhe-Min Coastal Current on the biogeographic pattern of microbial eukaryotic communities. Zhimeng Xu, Yifan Li, Yanhong Lu, Yingdong Li, Zhongwei Yuan, Minhan Dai, Hongbin Liu. PROGRESS IN OCEANOGRAPHY, 2020, 183, 102309.IF:4.06,SCI3. |

## 获取数据（2020 年度）

2020 年，“ 嘉庚 ” 号执行的航次获取的各类数据主要包括:

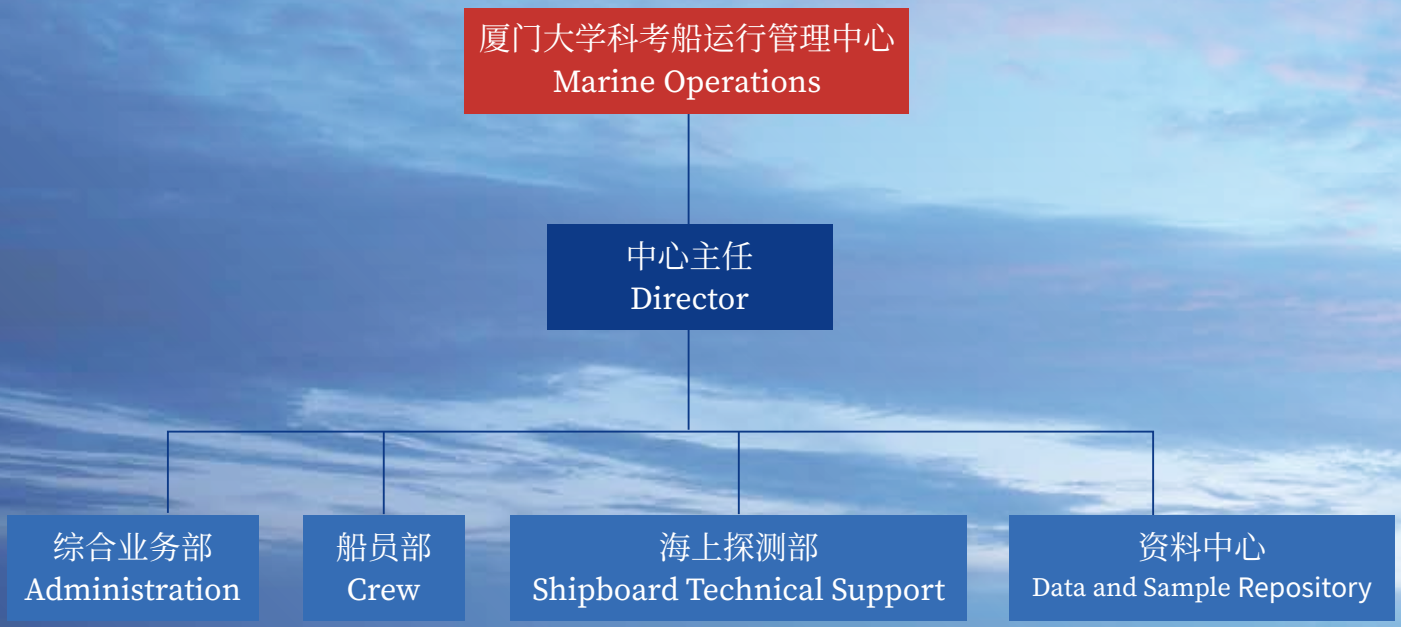
- 深水多波束数据 137GB
- 中浅水多波束数据 546GB
- 浅地层剖面数据 355GB
- 重力数据 5.2GB
- ADCP 数据 40GB
- 温盐深剖面数据 11.5GB
- 走航表层温盐数据 182MB
- 气象数据 600MB
- 走航多参数剖面调查断面长度 4630km

| 序号 | 论文标题、作者、刊名、时间 |
| --- | --- |
| 10 | Laterally transported particles from margins serve as a major carbon and energy source for dark ocean ecosystems. Jiaming Shen, Nianzhi Jiao, Minhan Dai, Haili Wang, Guoqiang Qiu, Jianfang Chen, Hongliang Li, Shuh-Ji Kao, Jin-Yu Terence Yang, Pinghe Cai, Kuanbo Zhou,Weifeng Yang, Yifan Zhu, Zhiyu Liu, Mingming Chen, Zuhui Zuo, Birgit Gaye, Martin G. Wiesner, Yao Zhang. GEOPHYSICAL RESEARCH LETTERS, 2020, 47, e2020GL088971.IF:4.497,SCI1. |
| 11 | Population genetic structure and gene expression plasticity of the deep-sea vent and seep squat lobster shinkaia crosnieri. Yao Xiao, Ting Xu, Jin Sun, Yan Wang, Wai Chuen Wong, Yick Hang Kwan, Chong Chen, Jian-Wen Qiu and Pei-Yuan Qian. FRONTIERS IN MARINE SCIENCE, 2020, 7.IF:3.661,SCI3. |
| 12 | Impacts of biogenic polyunsaturated aldehydes on metabolism and community composition of particle-attached bacteria in coastal hypoxia. Zhengchao Wu, Qian P. Li, Zaiming Ge, Bangqin Huang, Chunming Dong, BIOGEOSCIENCES DISCUSSIONS. 2020, 2020, 1-37.IF:3.48,SCI2. |
| 13 | 周怀阳 , 朱启宽 , 季福武 , 杨群慧 . 南海深水海山上的新发现 [J]. 科技导报 ,2020,38(18):83-88. |
| 14 | 陈婉莹 , 张东声 , 王春生 . 南海中部深海海山汁蛇尾属 (Ophiurothamnus) 二新记录种 ( 蛇尾纲 , 棘蛇尾科 )[J]. 海洋与湖沼 ,2020,51(03):649-655. |
| 15 | 程荣 , 钱生平 , 孙添力 , 周怀阳 . 基于计算机断层扫描的火山岩气孔含量及大小分布特征无损快速分析 [J]. 岩矿测试 ,2020,39(03):398-407. |
| 16 | *#Song X, #Lyu M, Zhang X, Ruthensteiner B, Ahn I, Pastorino G, Wang Y, Gu Y, Ta K, Sun J, Liu X, Han J, Ke C, *Peng X. (2021). Large plastic debris dumps: new biodiversity hot spots emerging on the deep-sea floor. Environmental Science & Technology Letters. (In Press) https://doi.org/10.1021/acs.estlett.0c00967 |

# 管理架构 / Management Structure

**厦门大学科考船运行管理中心负责“嘉庚”号的运行和管理，下设综合业务部、船员部、海上探测部及资料中心。**

**Marine Operations (XMU) is responsible for the operation of R/V Tan Kah Kee. It has four sectors: Administration, Crew, Shipboard Technical Support, Data and Sample Repository.**




**科考船运行管理委员会**

主任：戴民汉

委员：王克坚、王海黎、史大林、李庆顺、吴喜平、陈东军、张明智、张瑶、胡建宇、黄邦钦、商少平、蔡平河、戴民汉

秘书：卢婧、董晶

© 高志刚 Zhigang Gao

## 中心主任 Director

王海黎 Dr. Haili Wang

## 综合业务部 Administration

负责统筹、协调、督办科考船日常运作所有相关业务工作。

The admin office is responsible for coordinating and supervising all administration affairs that are relevant to R/V TKK's routine operation.

董晶、杨琇玲、陈蕾、林跃旬、赵凤飞、秦巧昀、黄家骏、刘秋玲

## 船员部 Crew

负责操控科考船海上的合法安全行驶，维护保障船载机具的正常使用，配合海上探测部执行探测作业。

The crew onboard R/V TKK are responsible for the legal and safe navigation at sea, maintaining and ensuring the daily usage of all shipborne equipment, and cooperating with STS for at-sea scientific operations.

尹龙、赵振明、温逢春、卢发根、陈晓晖、曾云鹤、朱青、傅春勇、陈真、洪坚强、李增阳、陈永山、周成廉、李福安、洪中山、蓝文平、曲平焕、沈楠欣

## 海上探测部 Shipboard Technical Support

负责全船所有船载科考装备及各类探测仪器设备的操作与维护，承担船上实验室的管理，并配合科研人员执行海上探测作业，确保船载科考设备的安全使用、操作和高质量数据的获取。

Shipboard Technical Support (STS) is a vital sector in Marine Operations (XMU). Its responsibility is to operate and maintain all scientific mission equipment, to manage shipborne laboratories, to coordinate and assist science parties to carry out various over-the-side operations onboard R/V TKK, such that to ensure the acquisition of high quality scientific data and samples at sea in a safe and efficient way.

吴学文、王鹏、叶成淼、陈希荣、陈若婷、汪建军、徐以正、高友炎、翁建伟、蔡建南、戴君伟、陈堃、许明珠

## 资料中心 Data and Sample Repository

负责汇整各航次的探测数据及航次报告，对每一航次的数据与标本进行品管、归档、储存。另对不同航次的探测参数分别做标准化分析处理及质量控制，绘制成图表，提交数据报告以供参考。

Data and Sample Repository is responsible for archiving, processing and quality control of all cruise data, as well as the archiving and storage of important samples collected from R/V TKK.

李立焰、朱佳、任晅、林智南

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# 水調歌頭・庚艫頌

艨艟幾時有？數代海洋殤。
當為風物放眼，籌策啟輝煌。
五載奔波騰挪，三千巍峨鋼軀，重譜新時章。
鄭重舒心願，法西了衷腸。

嘉庚名，南強夢，萬裹疆。
薪火相繼，血脈傳承樂共襄。
行時披星戴月，駐時徹夜繁忙，傾意哺群芳。
得東風無限，天涯亦巡航。

——作者 丁少雄

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